

FROM SENSOR TO ALGORITHM, FROM DATA TO CARE: THE TECHNOLOGICAL RECONFIGURATION OF THE EXPERIENCE OF LIVING WITH DIABETES IN BRAZIL

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Abstract

Diabetes mellitus is a chronic condition whose management has been transformed by the incorporation of digital technologies capable of expanding monitoring, self-care, and the production of clinical information. This study aimed to analyze how digital technologies, ranging from monitoring sensors to algorithmic systems, reconfigure the experience of living with diabetes in Brazil. The study was justified by the need to understand the effects of digitalization on care, considering clinical benefits, autonomy, accessibility, and equity. An integrative literature review was conducted through searches in PubMed,

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Scopus, Latindex, the CAPES Journals Portal, and Miguilim, encompassing studies published in Portuguese and English between 2021 and 2026. Publications related to glucose monitoring, smart devices, artificial intelligence, self-care, user experience, data security, and equity in access to technology were analyzed. The results indicate that sensors, continuous monitoring systems, connected devices, and algorithmic tools expand monitoring capabilities and may promote individualized decision-making and greater user participation in care. However, challenges were also identified regarding accessibility, technological inequality, usability, privacy, data security, and the need for professional training. It is concluded that digital transformation has the potential to enhance diabetes care, provided that its implementation preserves person-centeredness, professional mediation, and equitable access to technological resources.

Keywords: Artificial intelligence, Diabetes mellitus, Digital health, Health technology, Self-care.

INTRODUCTION

Diabetes mellitus is a chronic condition that requires continuous monitoring, metabolic control, and individualized care. In this context, the expansion of digital technologies has prompted changes in the ways care is monitored, delivered, and organized, introducing new possibilities for disease management and for individuals' participation in their own care (Daly; Hovorka, 2021).

The incorporation of sensors, continuous glucose monitoring devices, automated insulin delivery systems, and health applications has expanded the resources available for diabetes management. These tools facilitate the production of clinical information and its use in guiding therapeutic decisions, thereby contributing to the transformation of traditional care practices (Klonoff et al., 2021).

In the Brazilian context, the use of these resources must be understood in light of the care needs of people with diabetes and the organization of healthcare services. The Clinical Protocols and Therapeutic Guidelines for Type 1 and Type 2 Diabetes Mellitus establish guidance for managing these conditions and

constitute important references for care delivery and for contextualizing the possibilities of technological incorporation (Brasil, 2023; Brasil, 2026).

Despite the potential associated with digitalization, the adoption of technologies does not eliminate challenges related to the continuity and comprehensiveness of care. Differences in access to devices, the need to train professionals, and difficulties integrating data into healthcare services may affect the use of these resources and individuals' experiences (Bode et al., 2021).

Among the changes observed in care delivery, a notable development is the possibility of using continuously generated information to support clinical monitoring and individualize interventions. In type 2 diabetes and prediabetes, different technological solutions have been explored to assist with monitoring and condition management, expanding the range of alternatives available for care delivery (Liarakos et al., 2024).

At the same time, digitalization changes the dynamics of self-care by bringing clinical monitoring closer to patients' daily activities. Adaptive platforms and personalized technologies can organize longitudinal information and support long-term management strategies, facilitating an approach guided by individual needs (Bardram et al., 2023).

The experience of using these devices, however, extends beyond clinical outcomes and encompasses issues related to autonomy, usability, and the day-to-day demands of managing the disease. For children and adolescents with type 1 diabetes, for example, their relationship with these technologies also involves family members and caregivers, highlighting the shared dimension of care and the importance of considering the experiences of the different participants involved (Chhabra et al., 2021).

For older adults, technological incorporation requires attention to the particularities of aging and specific monitoring needs. Device suitability, accessibility, and the support provided by professionals are relevant aspects of understanding how digital resources can be integrated into the care of this population without disregarding their functional and individual circumstances (Huang et al., 2023).

Another element of this transformation is the growing use of digital systems to record, interpret, and communicate health-related information. Although these resources may expand monitoring possibilities, their application also requires reflection on privacy, data security, information overload, and the preservation of the human dimension of care relationships (Eberle; Stichling; Löhnert, 2021; Borisova; Vassileva, 2025).

Given these changes, it is important to investigate how technological innovation affects the experiences of people living with diabetes, considering both the possibilities for optimizing care and the challenges associated with the everyday use of devices. Analyzing these transformations makes it possible to discuss the relationship among monitoring, self-care, professional follow-up, and the organization of care, including the particularities of the Brazilian context (De Freitas et al., 2025; Everett et al., 2026).

Accordingly, this study aims to analyze how digital technologies, ranging from monitoring sensors to algorithmic systems, reconfigure the experience of living with diabetes in Brazil, considering their contributions to clinical monitoring, self-care, and the relationship between patients and healthcare professionals, as well as the challenges associated with access to, use of, and integration of these resources into care.

METHODOLOGY

TYPE OF STUDY

This is an integrative literature review with a qualitative, descriptive approach, developed to gather, systematize, and interpret scientific evidence concerning the use of digital technologies in the care of people with diabetes. An integrative review makes it possible to bring together different perspectives on a given phenomenon, facilitating the identification of trends, contributions, limitations, and gaps in scientific research.

The study was structured into six stages: defining the topic and formulating the guiding question; establishing the inclusion and exclusion criteria; defining the databases and descriptors; conducting the

search and selecting the studies; extracting and organizing the information; and analyzing and synthesizing the results. This structure enabled the research process to be conducted systematically and consistently with the proposed objective.

GUIDING QUESTION

The guiding question for this review was: How have digital technologies been reconfiguring the experience of living with diabetes in Brazil, considering monitoring, self-care, and healthcare?

Formulating this question made it possible to delimit the search to studies related to the use of technological resources in diabetes management, encompassing both devices used for clinical monitoring and digital tools intended for self-care, communication, and the organization of care.

DATABASES AND SEARCH STRATEGY

The bibliographic search was conducted in PubMed, Scopus, Latindex, the CAPES Journals Portal, and Miguilim, selected for their breadth and relevance in identifying studies related to health, technology, diabetes, and the digital transformation of care. The use of different sources was intended to expand the retrieval of publications and reduce the possibility of limiting the sample to a single bibliographic perspective.

The searches employed descriptors and keywords related to the study's main concepts, including the terms *"Diabetes Mellitus"*, *"Diabetes Technology"*, *"Digital Health"*, *"Telemedicine"*, *"Self-Care"*, *"Continuous Glucose Monitoring"*, *"Artificial Intelligence"*, *"Tecnologia em Saúde"*, *"Saúde Digital"*, *"Autocuidado"*, *"Monitoramento Contínuo da Glicose"* and *"Inteligência Artificial"*.

The descriptors were combined using the Boolean operators AND and OR, according to the particular features and search resources available in each database. The combinations used or adapted according to the platform included *"Diabetes Mellitus" AND "Digital Health"*, *"Diabetes Mellitus" AND "Diabetes Technology"*, *"Diabetes" AND "Self-Care"*, *"Diabetes Mellitus" AND "Continuous*

Glucose Monitoring” and “Diabetes” AND “Artificial Intelligence”. The strategies were adjusted to the specific characteristics of each database to broaden the identification of potentially eligible studies.

INCLUSION AND EXCLUSION CRITERIA

The inclusion criteria were scientific articles published between January 2021 and December 2026; studies available in Portuguese or English; publications for which the full text was available; research related to the use of digital technologies in the monitoring, treatment, self-care, or follow-up of people with diabetes; and studies whose results were directly related to the objective of this review.

National and international studies were considered eligible, provided that they made relevant contributions to understanding the relationship between digital technologies and the experience of living with diabetes. Studies addressing different technological modalities were also included, such as sensors, continuous glucose monitoring, applications, digital platforms, telemedicine, automated systems, artificial intelligence, and other tools intended for monitoring or managing the condition.

Studies duplicated across the databases consulted, publications predating 2021, studies published in languages other than Portuguese or English, studies without full-text availability, and publications that were not directly related to the topic under investigation were excluded. Editorials, letters to the editor, conference abstracts, commentaries, protocols without results, dissertations, theses, books, book chapters, and documents that did not meet the characteristics of a scientific article were also excluded.

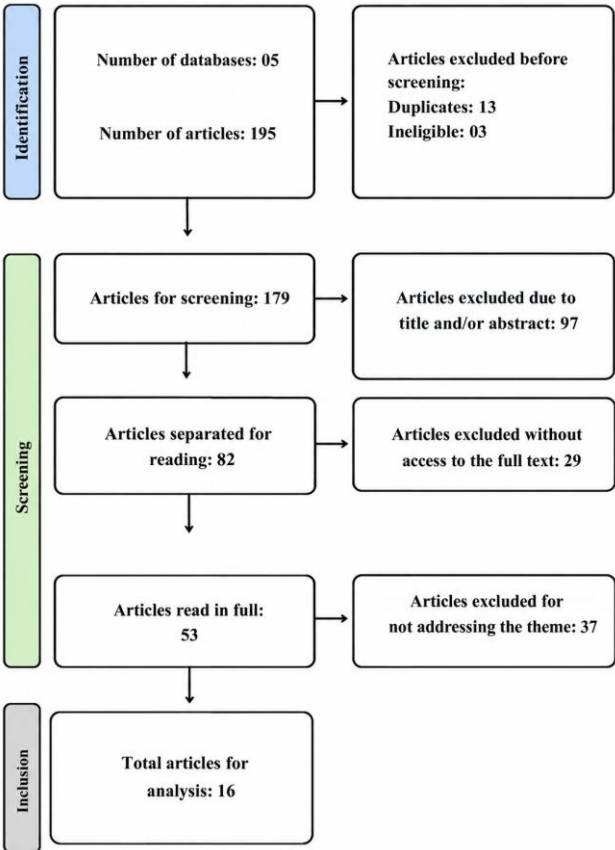
STUDY IDENTIFICATION AND SELECTION PROCESS

The selection process was conducted sequentially. Initially, searches were performed in the five selected databases using the previously established combinations of descriptors. The retrieved results were compiled to identify potentially relevant studies, after which duplicates were identified and removed.

Titles and abstracts were then screened according to the previously defined eligibility criteria. Studies that demonstrated a relationship with the topic were advanced to full-text review, during which their alignment with the objective of the review and compliance with the inclusion criteria were assessed.

The sequence of study identification, screening, eligibility assessment, and inclusion is presented in Figure 1, providing a systematic visualization of the methodological process used to compose the final sample.

Figure 1
Flowchart of the identification, selection, eligibility assessment, and inclusion of studies in the integrative review



Source: Prepared by the authors (2026).

DATA EXTRACTION AND ORGANIZATION

After the final sample was defined, the selected studies underwent full-text review and systematic extraction of the relevant information. To ensure uniformity in data organization, an instrument was

developed containing the following variables: author and year of publication; country in which the study was conducted; study objective; methodological design; population or context investigated; technology analyzed; main results; contributions to care; and identified limitations.

Organizing this information made it possible to compare the publications and identify different ways in which digital technologies are used in the care of people with diabetes. The data were subsequently grouped according to their characteristics and contributions to the subject under investigation.

ANALYSIS AND SYNTHESIS OF RESULTS

The selected studies were analyzed qualitatively, descriptively, and interpretively. Initially, the objectives, methods, and main results of each publication were examined. The findings were then compared to identify similarities, differences, and trends related to the incorporation of technology into the care of people with diabetes.

To synthesize the results, the findings were organized into thematic areas concerning glucose monitoring and control; digital technologies and self-care; patient experience; communication and relationships between users and professionals; personalization of care; artificial intelligence and algorithmic systems; and challenges related to access to, use of, and integration of technologies into healthcare services.

The interpretation of the results considered the relationship between technological innovation and healthcare, seeking to understand not only the clinical possibilities offered by digital resources but also their repercussions on the daily experiences of people living with diabetes. The synthesis therefore sought to integrate the technological, care-related, and experiential aspects found in the selected literature.

ETHICAL CONSIDERATIONS

Because this is an integrative literature review developed exclusively from secondary data obtained from previously published studies, the research did not involve the direct participation of human subjects and therefore did not require review by a Research Ethics Committee, in accordance with Resolution No. 510 of April 7, 2016, issued by the National Health Council.

TEMPORAL AND LINGUISTIC SCOPE

The review was limited to the period from 2021 to 2026, seeking to encompass contemporary scientific research on the expansion of digital technologies applied to diabetes care. Studies published in Portuguese and English were considered to include both Brazilian scientific research and international evidence relevant to understanding the phenomenon.

The selected time frame makes it possible to analyze a period marked by the expansion of monitoring resources, digital platforms, decision-support systems, artificial intelligence, and other technologies applied to diabetes care. The studies were selected by applying the previously established criteria, without using estimated numbers or including publications that did not meet the eligibility criteria.

RESULTS AND DISCUSSION

The searches conducted in PubMed, Scopus, Latindex, the CAPES Journals Portal, and Miguilim identified studies related to the incorporation of digital technologies into the care of people with diabetes. After the inclusion and exclusion criteria were applied, the publications most closely aligned with the objective of the review were selected, encompassing different technological resources, user experiences, monitoring strategies, and possibilities for improving care.

Table 1 characterizes the studies included in the review according to authorship, year of publication, study objective, thematic area, and main findings and contributions to diabetes care.

Table 1*Characteristics of the studies included in the integrative review*

No.	Author/Year	Study objective	Thematic area	Main findings
1	Makroum et al. (2022)	To analyze the application of machine learning and smart devices in diabetes management.	Artificial intelligence and smart devices	Machine-learning technologies and connected devices have potential applications in monitoring, prediction, and decision support, although challenges related to validation, interoperability, and clinical use remain.
2	Glennie; Berard; Levrat-Guillen (2022)	To examine the value of sensor-based technologies for people with diabetes and healthcare systems.	Sensors and digital monitoring	Sensor-based technologies can expand the collection of glycemic and behavioral data, facilitate individualized monitoring, and contribute to more informed clinical decisions.
3	Agarwal; Simmonds; Myers (2022)	To discuss the potential and limitations of technologies in reducing inequalities in diabetes-related health outcomes.	Equity and access to technology	Technology can expand opportunities for care and monitoring, but economic, social, and structural barriers may limit its reach and reproduce existing inequalities.
4	Mackenzie; Sainsbury; Wake (2023)	To review the landscape, possibilities, and challenges of artificial intelligence applied to diabetes beyond closed-loop systems.	Artificial intelligence	Artificial intelligence has potential applications in prediction, diagnosis, therapeutic personalization, and decision support, but requires attention to data quality, validation, security, and integration into clinical practice.
5	Yoo; Kim (2023)	To analyze advances in continuous glucose monitoring and integrated devices for people receiving insulin-based therapies.	Continuous glucose monitoring	The evolution of monitoring systems and their integration with therapeutic devices expand the ability to track glycemic patterns and may promote better metabolic control.
6	Elian et al. (2023)	To review the technologies currently used in type 1 diabetes management and their effects on quality of life.	Type 1 diabetes and quality of life	Insulin pumps, continuous monitoring, and automated systems can promote glycemic control and reduce some of the daily burden of treatment, although technological experiences vary among users.
7	Jacobsen et al. (2023)	To systematize evidence on the utility and precision of technologies used in the treatment of type 1 diabetes.	Technological effectiveness and precision	The evidence supports the benefits of different technologies in type 1 diabetes management, but the magnitude of their effects varies according to the device, context of use, and outcomes assessed.

8	Natale et al. (2023)	To synthesize patients' experiences with continuous glucose monitoring and sensor-augmented insulin pump systems.	Patient experience	Users report benefits related to glycemic awareness, safety, and autonomy, but also identify difficulties of use, discomfort, device visibility, and effects on their routines.
9	Maqbool et al. (2023)	To develop and analyze an intelligent healthcare system based on sensing technologies for people with diabetes.	Smart sensing	Intelligent systems can integrate physiological data and support remote monitoring, enabling more continuous follow-up that may be more responsive to changes in health status.
10	Shomali et al. (2024)	To identify the fundamental elements of digital health applied to the care of people with diabetes and cardiometabolic conditions.	Digital health and integrated care	The effectiveness of digital health depends on the integration of data, devices, professionals, and users, as well as interoperability, security, usability, and appropriate incorporation into care workflows.
11	Liarakos; Crabtree; Wilmot (2024)	To analyze which patient-reported outcomes are relevant to the assessment of diabetes technologies.	Patient-centered outcomes	Technology assessment should incorporate quality of life, satisfaction, treatment burden, autonomy, and user experience in addition to exclusively clinical indicators.
12	Bertolazzi et al. (2024)	To examine security and privacy issues related to the use of health technologies by people with diabetes.	Security, privacy, and data	The growing production and circulation of health data expand care possibilities but also create risks related to the protection, storage, sharing, and governance of information.
13	Barone et al. (2025)	To understand the lived experience of people with diabetes using accessible point-of-care technologies in the Brazilian context.	Lived experience and accessibility in Brazil	Technological accessibility can strengthen autonomy and participation in care, while barriers to access and usability influence how resources are incorporated into daily experience.
14	Vauthier et al. (2025)	To qualitatively explore the use of technologies for type 1 diabetes management among people participating in ultra-endurance activities.	Technology, self-care, and high-demand situations	Technologies are used for monitoring and decision-making during prolonged physical activity, demonstrating the importance of continuous information adaptable to individual needs.
15	Salomon; Sam (2026)	To discuss the relationship between technological innovation and equity in the care of people with diabetes.	Technological innovation and equity	Technological expansion can broaden care possibilities, but its benefits are not automatically distributed equitably, requiring attention to access barriers and socioeconomic differences.

16	Cardona-Hernández; Tinti; Delvecchio (2026)	To present contemporary perspectives on the development and application of technologies for diabetes care.	Technological innovation in diabetes	Technological development expands the possibilities for monitoring, treatment, and personalization of care, reinforcing the need to integrate innovation, clinical evidence, and patient needs.
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Source: Prepared by the authors (2026).

The technological transformation of diabetes care reflects a gradual shift from a model predominantly centered on periodic appointments toward a dynamic supported by the continuous production of information. Mackenzie, Sainsbury, and Wake (2023) highlight that artificial intelligence expands the possibilities for interpreting large volumes of data, while Shomali et al. (2024) emphasize the need to integrate data, devices, professionals, and users. Taken together, these findings indicate that technological innovation is not limited to introducing new equipment but changes the very logic by which the chronic condition is monitored.

In the field of glucose monitoring, Yoo and Kim (2023) demonstrate that developments in continuous monitoring systems and integrated devices have expanded the ability to track metabolic variations more dynamically. Glennie, Berard, and Levrat-Guillen (2022) reach a similar conclusion, noting that sensor-based technologies can generate information relevant to clinical monitoring. This convergence suggests that continuous data collection may facilitate a more detailed understanding of glycemic fluctuations and support interventions tailored to individual needs.

Artificial intelligence adds an analytical dimension to this process by transforming collected data into information that may be useful for decision-making. Mackenzie, Sainsbury, and Wake (2023) identify applications extending beyond automated insulin delivery systems to include prediction and personalization. Makroum et al. (2022), in turn, demonstrate the use of machine learning associated with smart devices to support diabetes management. The relationship between these studies reinforces the potential of algorithmic systems to shift some aspects of care from a reactive perspective toward strategies guided more closely by pattern analysis.

From the perspective of type 1 diabetes, Jacobsen et al. (2023) identify evidence concerning the utility and precision of different technologies used in treatment. Elian et al. (2023) complement this understanding by associating technological resources with metabolic control and quality of life. The convergent findings indicate that the relevance of technologies should not be assessed exclusively by their ability to produce data or achieve specific clinical indicators, but also by how these resources affect the everyday experience of treatment.

User experience is therefore an indispensable dimension in understanding the technological reconfiguration of care. Natale et al. (2023) demonstrate that people using continuous monitoring and infusion systems recognize benefits associated with glycemic awareness, safety, and autonomy, but also report discomfort and interference with their routines. Liarakos, Crabtree, and Wilmot (2024) advocate an assessment that incorporates outcomes reported by patients themselves. The agreement between these contributions shows that technological effectiveness must also be understood from the subjective and practical experiences of those who use the devices.

Another relevant aspect concerns the personalization of care made possible by the availability of information closer to people's daily lives. Shomali et al. (2024) observe that digital health depends on coordination among different technological and care-related components, while Maqbool et al. (2023) present sensing systems capable of integrating physiological information for intelligent monitoring. This coordination supports individualized strategies in which data cease to represent isolated records and instead form part of a longitudinal monitoring trajectory.

Technological incorporation also redefines self-care practices, particularly when devices allow individuals to monitor parameters related to their own condition. In their study of people with type 1 diabetes participating in ultra-endurance activities, Vauthier et al. (2025) demonstrate how technological resources can support decisions in contexts in which metabolic needs change rapidly. Natale et al. (2023) likewise identify relationships among technology, autonomy, and awareness of the condition. These

results indicate that the device can mediate among clinical knowledge, bodily perception, and everyday decision-making.

In the Brazilian context, accessibility is particularly important if technological innovation is not to remain restricted to groups with greater resources. From the perspective of lived experience in Brazil, Barone et al. (2025) demonstrate that accessible point-of-care technologies can help strengthen autonomy. Agarwal, Simmonds, and Myers (2022) add that technologies can both address and reproduce health inequalities, depending on the conditions of access and use. The relationship between these studies demonstrates that innovation must be analyzed simultaneously in terms of technological capacity and social reach.

In this respect, inequalities in access are among the principal factors to be considered when interpreting technological benefits. Agarwal, Simmonds, and Myers (2022) identify economic and structural barriers that may limit the distribution of technology's benefits, while Salomon and Sam (2026) revisit the tension between innovation and equity in diabetes care. The authors' agreement demonstrates that expanding digital tools does not automatically democratize care, because connectivity, device availability, digital literacy, and the ability to use these resources affect their adoption.

The increasing production of data also introduces challenges related to security and privacy. Bertolazzi et al. (2024) emphasize that the datafication of care expands the circulation of sensitive information and therefore requires protection and governance mechanisms. Shomali et al. (2024) similarly identify security and data integration as fundamental components of digital health. Thus, the greater the volume of information produced by sensors, applications, and platforms, the greater the need to establish responsible practices for storing, sharing, and using data.

At the same time, the expansion of digital resources changes the boundaries between care provided within healthcare services and care undertaken in daily life. Glennie, Berard, and Levrat-Guillen (2022) associate sensor-based technologies with expanded monitoring, while Maqbool et al. (2023) demonstrate monitoring possibilities supported by intelligent systems. This transformation may promote

greater continuity of information across different stages of care, but it requires the data produced to be effectively incorporated into care processes and interpreted by trained professionals.

Technology assessment must consequently extend beyond a strictly instrumental perspective. Liarakos, Crabtree, and Wilmot (2024) emphasize the importance of patient-reported outcomes, while Jacobsen et al. (2023) highlight the need to analyze evidence of utility and precision. Elian et al. (2023) add quality of life as a relevant dimension in assessing resources intended for type 1 diabetes. The convergence of these perspectives supports a multidimensional understanding of effectiveness in which clinical outcomes, user experience, safety, usability, and everyday impact are considered jointly.

The incorporation of algorithmic systems also requires a critical stance toward the growing automation of care-related decisions. Mackenzie, Sainsbury, and Wake (2023) identify challenges associated with artificial intelligence, while Makroum et al. (2022) demonstrate these systems' dependence on data quality and validation processes. In this regard, the algorithm must be understood as a support resource rather than an isolated element of the care process, particularly because diabetes-related decisions involve clinical, behavioral, and contextual characteristics that cannot be reduced exclusively to computational patterns.

Finally, the literature analyzed demonstrates that the technological reconfiguration of the experience of living with diabetes occurs through the coordination of sensors, data, algorithms, therapeutic devices, professionals, and users. Barone et al. (2025) highlight the relevance of lived experience in the Brazilian context, while Salomon and Sam (2026) emphasize that innovation must be accompanied by attention to equity. Thus, the digital transformation of care has the potential to expand monitoring, support decisions, strengthen self-care, and personalize interventions, but its effective contribution depends on integrating innovation, scientific evidence, accessibility, data security, and person-centeredness in the care process.

CONCLUSION

The synthesis of the studies analyzed demonstrates that digital transformation has been significantly changing how diabetes is monitored and managed. Sensors, connected devices, digital platforms, and algorithmic resources expand the availability of information about the clinical condition and enable monitoring that more closely reflects the fluctuations occurring in individuals' daily lives.

The review findings also indicate that the use of these tools may promote greater monitoring precision, support for therapeutic decisions, and the development of individualized strategies. Artificial intelligence and continuous monitoring systems stand out for their ability to process different sets of information, while smart devices expand opportunities for individuals to participate in the everyday management of their treatment.

Regarding the guiding question, the analysis shows that technologies reconfigure the experience of living with diabetes by bringing clinical monitoring closer to daily life. The continuous production of data changes the ways in which condition-related changes are perceived, recorded, and communicated, creating new forms of interaction among users, devices, and professionals and progressively making care more oriented toward information produced in real time or near real time.

However, incorporating these resources also reveals limitations that must be considered. Socioeconomic inequalities, difficulties of access, usability, the need for training, privacy, and data security are factors that may affect the effectiveness of digital solutions. Technological innovation therefore should not be understood only in terms of devices' technical capabilities, but also in terms of the conditions that enable their proper and continuous use.

In relation to the established objective, it is concluded that digital technologies play a relevant role in reconfiguring diabetes care, particularly by expanding the possibilities for monitoring, self-care, personalization, and communication. Nevertheless, their incorporation must preserve person-centeredness and the role of professionals, establishing a balanced relationship among automated resources, clinical interpretation, and individual needs.

To deepen this understanding, longitudinal studies should be conducted in Brazil to follow different profiles of people with diabetes while they use digital technologies. Future research could relate clinical indicators, user experience, quality of life, autonomy, accessibility, and equity, producing evidence capable of guiding safer and more inclusive technology implementation strategies compatible with the different realities of the healthcare system.

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